Endovascular Treatment of Berry Intracranial Aneurysms Using a New Detachable Coil System

(DCS® - Detachable Coil System Cook)

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Summary

We aimed to assess and to demonstrate the efficiency of a new mechanical system in the endovascular treatment of berry intracranial aneurysms.

From September 1999 to October 2000, 38 patients with 40 aneurysms experienced selective embolization using Detach Coils (DCS® - Cook).They were 12 men and 26 women, aged 26 to 77 years, mean age 53.4. The clinical status of patients was graded by Hunt and Hess scale: Stage 0: 8 - stage I: 3 - Stage II: 11 - Stage III: 11 - Stage IV: 2 - Stage V: 3. The localization of aneurysms was as follows: internal carotid artery: 11; sylvian artery: 10; anterior communicating artery: 5; anterior cerebral artery A1-A2: 5; intra-cavernous carotid artery: 1; basilar trunk: 5; PICA: 2; posterior cerebral artery: 1. The size of the aneurysms ranged from 2 to 40 mm. For embolization of aneurysms, we utilized 242 coils (mean number 6.05). The shape and size of coils varied as follows: longest J 6.25 - shortest J 4-3 - longest S 10-20 - shortest S 2-2.

The mean time of procedure was 43 minutes (max 180 minutes - min 7 minutes). We did not have any technical complications during the procedure and no immediate rebleeding occurred. Initial follow-up of the patients showed angiographic full occlusion.

Detach Coils appear to be a very precise, reliable and rapid system, with high stability during coil detachment (in very small or very giant aneurysms) in the embolization of intracranial aneurysms, with an interesting aspect concerning the low cost of this new mechanical device.

Introduction

Since its introduction, endovascular treatment (EVT) of intracranial aneurysms has considerably improved its role in the management of subarachnoid hemorrhage (SAH) due to aneurysmal rupture [1,2,3,4]. Currently, in our institution, the majority of the aneurysms are referred for EVT

Different coil detachment systems are available for EVT of aneurysms, some electrical like GDC (Boston Scientific, France) [5] and others mechanical like ITC (Boston Scientific, France) [6,7,8] or MDS (Balt, France) [9,10].

Table 1 **Pattern of patients based on age and sex**

Patients	Percentage	Mean age
Women : 26	68%	50.4
Men : 12	32%	56.4

Table 2 **Patients graded for Hunt and Hess scale**

Grading Hunt and Hess	Number of patients
0	8
I	3
II	11
III	11
IV	2
IV-V	3
0 to II : 57.8%	
III to V : 42.2%	

Table 3 **Distribution of aneurysms considering topography**

Localization	Number	Percentage
Carotid system: 80%		
Internal carotid artery	11	27.5%
Sylvian artery	10	25%
Anterior communicating artery	5	12.5 %
Anterior cerebral artery A1-A2	5	12.5 %
Intracavernous carotid artery	1	2.5 %
Vertebrobasilar system: 20%		
Basilar trunk	5	12.5%
PICA	2	5%
Posterior cerebral artery	1	2.5%

Since September 1999 we have been using in our institution a new mechanical detachable device, Detach Coil System (William Cook Europe, Denmark). This work evaluates the results of EVT procedures using DCS in a prospective and preliminary study over one year concerning all the different sizes and localizations of intracranial aneurysms in various clinical conditions.

Materials and Methods

Patients and aneurysms data

From September 1999 to October 2000, 38 patients with 40 aneurysms underwent endovascular treatment by Detach Coils [11]. They comprised 26 women (68%) mean age 50.4 years and 12 men (32%) mean age 56.4 (table 1).

In the same period, we treated 12 patients with MDS platinun (Balt, France), all with good results. No more patients were treated with GDC because the procedure lasts for a long time, the material is more expensive and we have experienced thrombotic complications mainly in the aneurysms of the median cerebral artery.

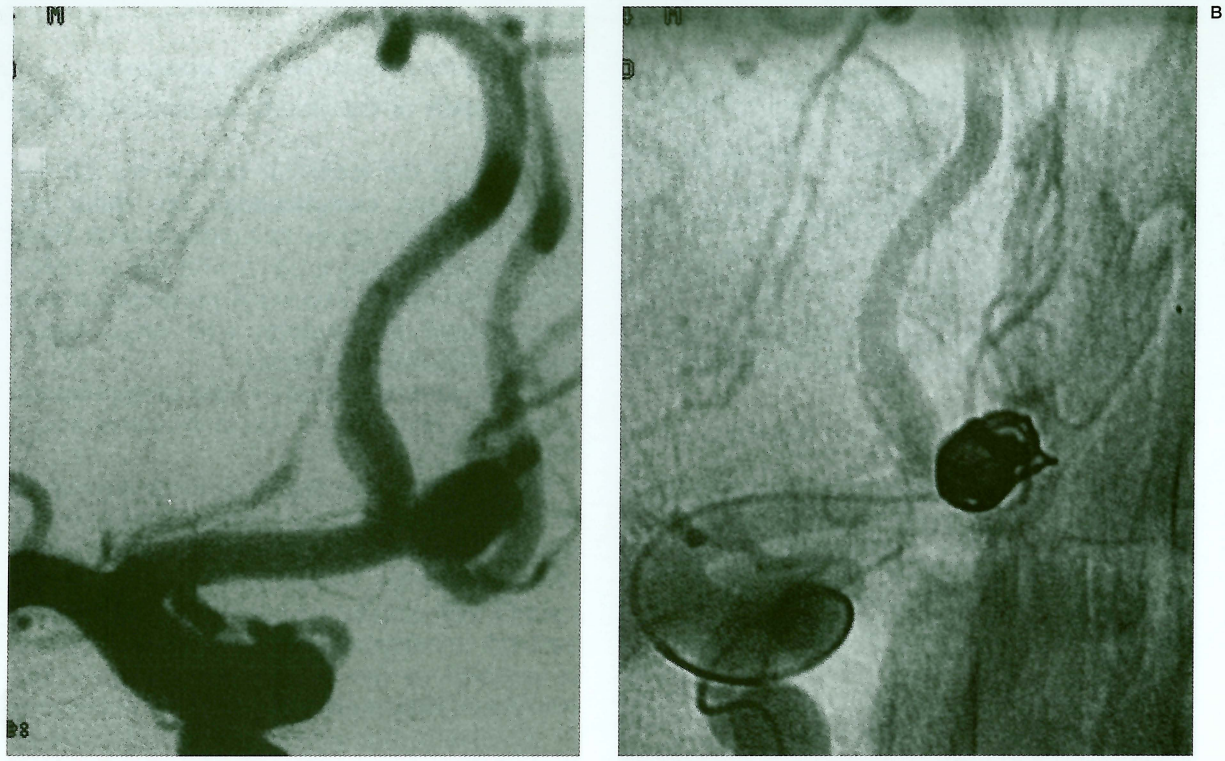
Clinical details are summarised in table 2.

The localization of the aneurysms varied and is described in table 3. Two patients had multiple aneurysms (two each). The size of the aneurysms ranged from 2 to 40 mm: they are considered and classified in tables 4 and 5.

Detachable Coil System (table 6)

The Detachable Coil System is a mechanical device composed of a coil and a delivery guidewire. The coil is made of platinum and is shaped in two ways :spiral and J-shape. The coil is screwed in the tip of the delivery guidewire .

Coil insertion requires two specific adapters through the hemostatic valve of the microcatheter. Then the coil is advanced into the microcatheter by sliding the delivery guidewire until the radiopaque marker of the delivery wire is just up to the proximal marker of the microcatheter. At which time we can detach the coil by holding tight the proximal part of the locking device and by turning the locking device counterclockwise approximately 25 turns. The delivery guidewire is then slowly removed and another coil could be inserted in the same way if needed.



Procedure

All the procedures were performed with general anesthesia and full systemic heparinization in order for activated clotting time to be kept around twice the base value (Hence, intravenous bolus of 50 mg of Heparin, then 1 to 2 mg/hour intra-venous). In cases of subarachnoid hemorrhage (SAH) Nimodipine (Nimotop, Bayer, Sens, France) is given (0.03 mg/hour/kg).

Through a 6F introducer by femoral route (Terumo, Belgium) a 5 or 6F guiding catheter (Cas. Balt, France), or Envoy (Cordis Endovascular System, USA) is gently pushed selectively into the carotid or vertebral artery.

All the procedures were analyzed using the Integris V3000 System (Philips Medical System, The Netherlands) with both fast subtracted rotation system and selective road mapping so that the aneurysm and the parent vessels were well analyzed.

The microcatheter (Marco 10 or 18, Balt, France) (Prowler 10 or 14 Cordis Endovascular System, USA) is gently advanced into the very bulk of the aneurysm, using 0.12 microguidewire (Terumo, Belgium) with 45° or 90° tip angulation. In some cases, a gentle curve is

Figure 1 Embolization of an anterior communicating artery aneurysm: in 30 minutes. 2 spiral coils, 2 DCS 18.

Table 4 **Classification of patients regarding size of aneurysms (I)**

Size of aneurysms: from 2 to 40 mm - Mean size: 8.8 mm		
Size	**Number**	**Percentage**
2 → 4 mm	14	35%
5 → 10 mm	14	35%
11 → 25 mm	8	20%
> 25 mm	4	10%

Table 5 **Classification of patients regarding size of aneurysms (II)**

Classification of size		**Number of patients**	**Percentage**
Baby aneurysms	2 - 2 mm	2	5.2%
Small aneurysms	3 - 4 mm	12	31.5%
Medium aneurysms	5 - 10 mm	12	31.5%
Large aneurysms	11 - 25 mm	8	21%
Giant aneurysms	> 25 mm	4	10.5%

Table 6 **Coils used in our study**

Coil type	**Smallest coil**		**Largets coil**	
	Diameter (mm)	**Length (cm)**	**Diameter (mm)**	**Length (cm)**
DCS 11 S	2	2	5	10
DCS 18 S	4	6	10	20
DCS S 18 S	5	12	10	20
DCS 11 J	4	3	4	10
DCS 18 J	4	15	10	20
DCS S 18 J	4	15	6	25

steam-shaped at the tip of the microcatheter according to the angulation of both the parent vessels and the collar of the aneurysm as well.

The efficacy of the embolization is appreciated with the full packing of the coils into the aneurysm. Great care should be paid to the parent vessels especially at the neck of the aneurysm.

Results

Regarding the patients and the aneurysms

The details of the results are summarized in tables [6,7,8,9].

Regarding the technical aspects, we did not experience any complications, but three patients died in our series: two patients with Hunt and Hess and Fisher grade 4 with full occluded basilar aneurysms. The third presented a new subarachnoid hemorrhage with large hematoma during the procedure.

In two cases, we failed to treat asymptomatic aneurysms: they were 2 mm in diameter with a large neck.

We performed an angiographic follow-up at three and six months to evaluate the degree of occlusion: among 40 aneurysms, 34 (85%) were considered fully occluded and 6 (15%) remained with circulating portions at the level of the neck (incompletely occluded) due to partial compaction of the coils, needing further embolization. They were giant or large aneurysms (> 10 mm) in the sylvian or carotid territory. One of them was on the anterior communicating artery and underwent EVT in emergency with severe angiospasm (table 7).

Regarding the procedure

Both timing of the procedure, characteristic and number of coils used are summarised in table 8. The mean time of procedure was 43 minutes ranging from 7 to 180 minutes.

In 40 aneurysms, we placed 242 coils (mean of 6.05 coils per aneurysms), of which 37 were J-shaped coils, especially chosen for eight large aneurysms and four giant aneurysms.

Discussion

The goal of this work is not to discuss about the EVT of aneurysms which is well established in most of the institutions and progresses constantly [12]. We present, to our knowledge, the first prospective study concerning a new mechanical system (DCS) in the endovascular treatment of intracranial aneurysms.

EVT by coils is currently considered the first treatment for intracranial berry aneurysms in a large number of institutions. In this way, the coiling of aneurysms should be safe and reliable considering both the clinical status of the patients and the kind of the aneurysms.

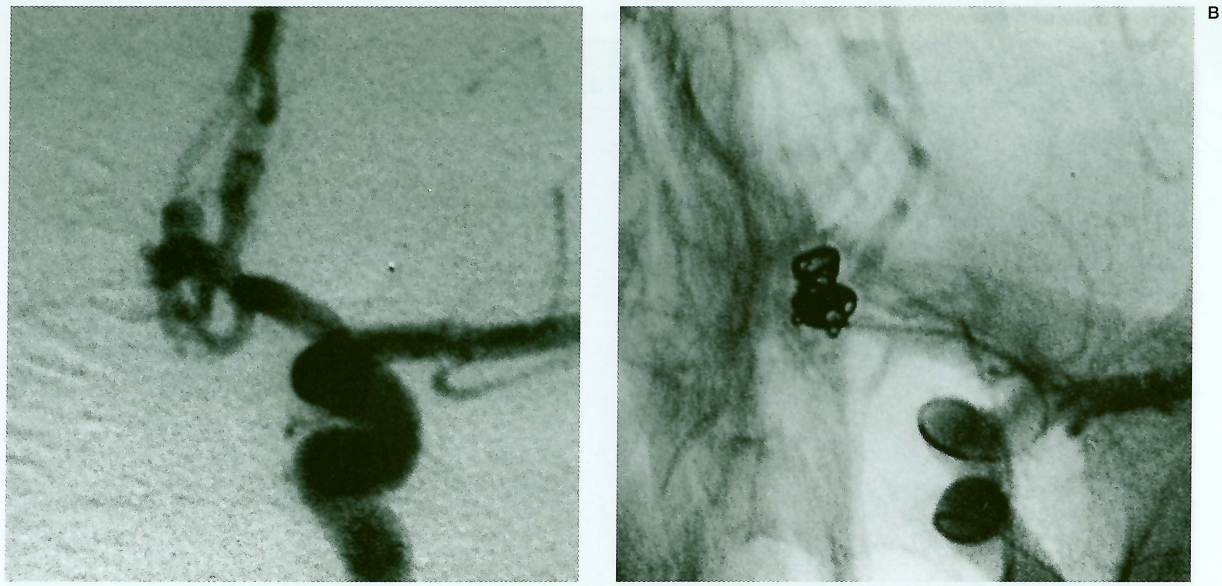


Figure 2 Embolization of an initial segment of the left anterior cerebral artery aneurysm: in 20 minutes. 4 spiral coils, 1 DCS 18 - 3 DCS 11.

Since 1993 and the beginning of the first experience with endovascular treatment of intracranial aneurysms, new devices have appeared with some new features to treat most intracranial aneurysms rapidly and safely by endovascular procedure.

On the other hand, due to the increasing number of EVT procedures and to the improvement of some devices, the cost of the procedures have risen and this fact should be considered in a global analysis of endovascular treatment by different systems.

Technical aspects

A detailed analysis of our 40 procedures points out some features concerning DCS. This

Table 7 **Follow-up of EVT at 3 and 6 months**

Efficiency of EVT by DCS	**Number of aneurysms**	**Percentage**
Incomplete occlusion	6	15%
Full occlusion	34	85%
(A = 40)		
Patient death (S.A.H.) (P = 38)	3	7.8%

Table 8 **Procedure data**

Mean time of procedure:	43 minutes (min. 7 minutes - max. 180 minutes)
Mean number of coils:	6.02 concerning 40 aneurysms Total coils: 242 37 J-shape coils used for 8 large and 4 giant aneurysms

Table 9 **Patient data**

Case n°	Localization	Sex / Age (y) of patients	Final result (at 6 months)
1	*Internal carotid artery*	fem / 42	Complete occlusion
2	»	mal / 44	Complete occlusion
3	»	mal / 43	Complete occlusion
4	»	fem / 54	Complete occlusion
5	»	mal / 64	Complete occlusion
6*	»	fem / 38	Complete occlusion
7*	» (same patient as n° 6)	fem / 38	Complete occlusion
8	»	fem / 47	Complete occlusion
9	»	mal / 65	*Incomplete occlusion*
10	»	fem / 39	Complete occlusion
11	»	fem / 75	*Incomplete occlusion*
12	*Intracavernous artery*	fem / 40	*Incomplete occlusion*
13	*Anterior communicating artery*	mal / 46	*Incomplete occlusion*
14	»	fem / 54	Complete occlusion
15	»	mal / 75	Complete occlusion
16	»	fem / 77	Complete occlusion
17	»	fem / 71	Complete occlusion
18	*Anterior cerebral artery A1-A2*	mal / 26	Complete occlusion
19	»	fem / 73	Complete occlusion
20	»	fem / 40	Complete occlusion
21	»	fem / 48	Complete occlusion
22*	»	mal / 45	Complete occlusion
23	*Sylvian artery*	mal / 46	Complete occlusion
24*	» (same patient as n° 22)	mal / 45	Complete occlusion
25	»	mal / 50	*Incomplete occlusion*
26	»	fem / 38	Complete occlusion
27	»	fem / 61	Complete occlusion
28	»	fem / 36	Complete occlusion
29	»	fem / 75	Complete occlusion
30	»	fem / 56	Complete occlusion
31	»	fem / 42	Complete occlusion
32	»	fem / 65	Complete occlusion
33	*Posterior cerebral artery*	fem / 52	Complete occlusion
34	*Basilar trunk*	fem / 50	Complete occlusion
35	»	fem / 51	Complete occlusion
36	»	fem / 60	*Incomplete occlusion*
37	»	mal / 43	Complete occlusion
38	»	mal / 70	Complete occlusion
39	*Pica*	fem / 46	Complete occlusion
40	»	fem / 42	Complete occlusion

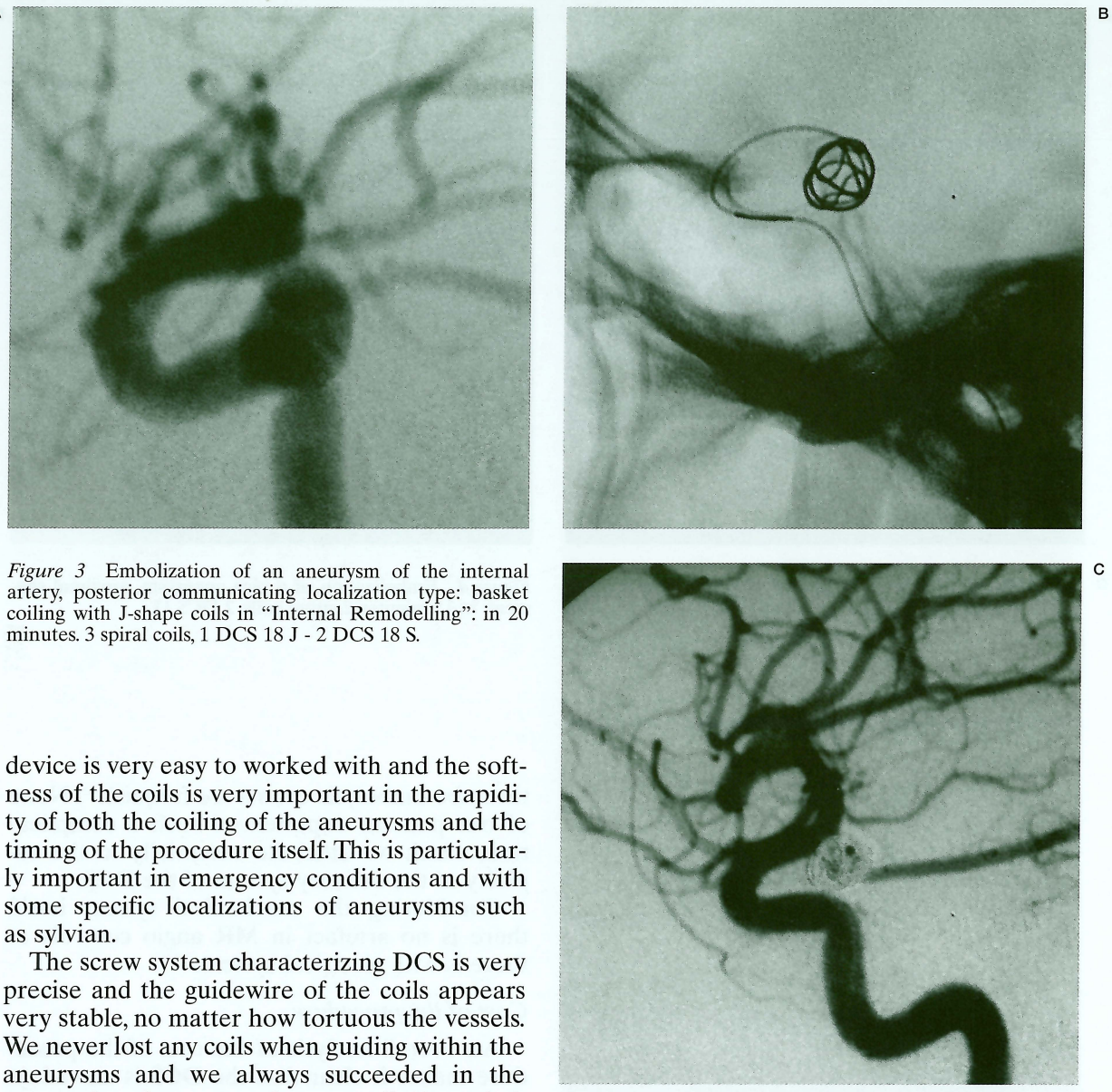


Figure 3 Embolization of an aneurysm of the internal artery, posterior communicating localization type: basket coiling with J-shape coils in "Internal Remodelling": in 20 minutes. 3 spiral coils, 1 DCS 18 J - 2 DCS 18 S.

device is very easy to worked with and the softness of the coils is very important in the rapidity of both the coiling of the aneurysms and the timing of the procedure itself. This is particularly important in emergency conditions and with some specific localizations of aneurysms such as sylvian.

The screw system characterizing DCS is very precise and the guidewire of the coils appears very stable, no matter how tortuous the vessels. We never lost any coils when guiding within the aneurysms and we always succeeded in the eventual replacement of some coil, if needed: this system allows good maintenance of the coils and precision of the placement.

Additionally, a slow and soft movement of the coils inside the aneurysm can be noticed during detachment, but we never had any dislodgement of the coils previously positioned.

In our opinion, these qualities are of great importance for the security and the reliability of the DCS system.

Special features of DCS coils

With both DCS 11 and 18, J-shape coils of various degrees of softness are available with different distal diameter curves. These offer features of high interest: with large or giant aneurysms, we can easily unroll the J-shape coil to make a very effective basket in a real 3D shape depending on the morphology of the aneurysm, considering that at the beginning a J-shape coil as large as possible must be always selected.

From this point of view, and especially with DCS 18, the J-shape coil allows to close the neck well by three or more loops and also creates an internal framework for supporting the positioning of the following coils , what we have called "intern remodeling".

Figure 4 Embolization of a pica aneurysm, proximal segment: in 15 minutes. 2 spiral coils, 2 DCS 11.

On the other hand, in some cases of large neck or fusiform aneurysms, we used DCS with an endoprothesis (Medtronic, France) to obtain a full embolization without bulging of the coils in the parent vessel, thereby avoiding micro-balloon remodeling, sometimes dangerous and always time-consuming [13,14,15].

Concerning the data procedures

The mean time of our procedures is about 43 minutes. This is an important point of interest especially with sylvian aneurysms, where thrombo-embolytic events are frequent [16]. None of our patients experienced such a complication, which we attribute essentially to the rapidity of the delivery system of the DCS.

Considering the mechanical system itself, there is no artefact in MR angio controls as there is with electrical systems [17,18].

Cost of the procedure

An overall analysis of the cost of the procedure makes it clear that the DCS is nowadays the least expensive of the systems available for use due to: the price of each coil DCS per se is threefold less expensive in comparison a GDC; with the advent of the J-shaped coil, a smaller number of coils can be placed; the quick feasibility of the DCS results in less time of anesthesia and heparinization, as well as minor complications, thus, leading to a shorter period of hospitalization.

Conclusions

Over a one year period in all the clinical situations, and especially in emergency, we experienced the Detach Coil System as a new me-

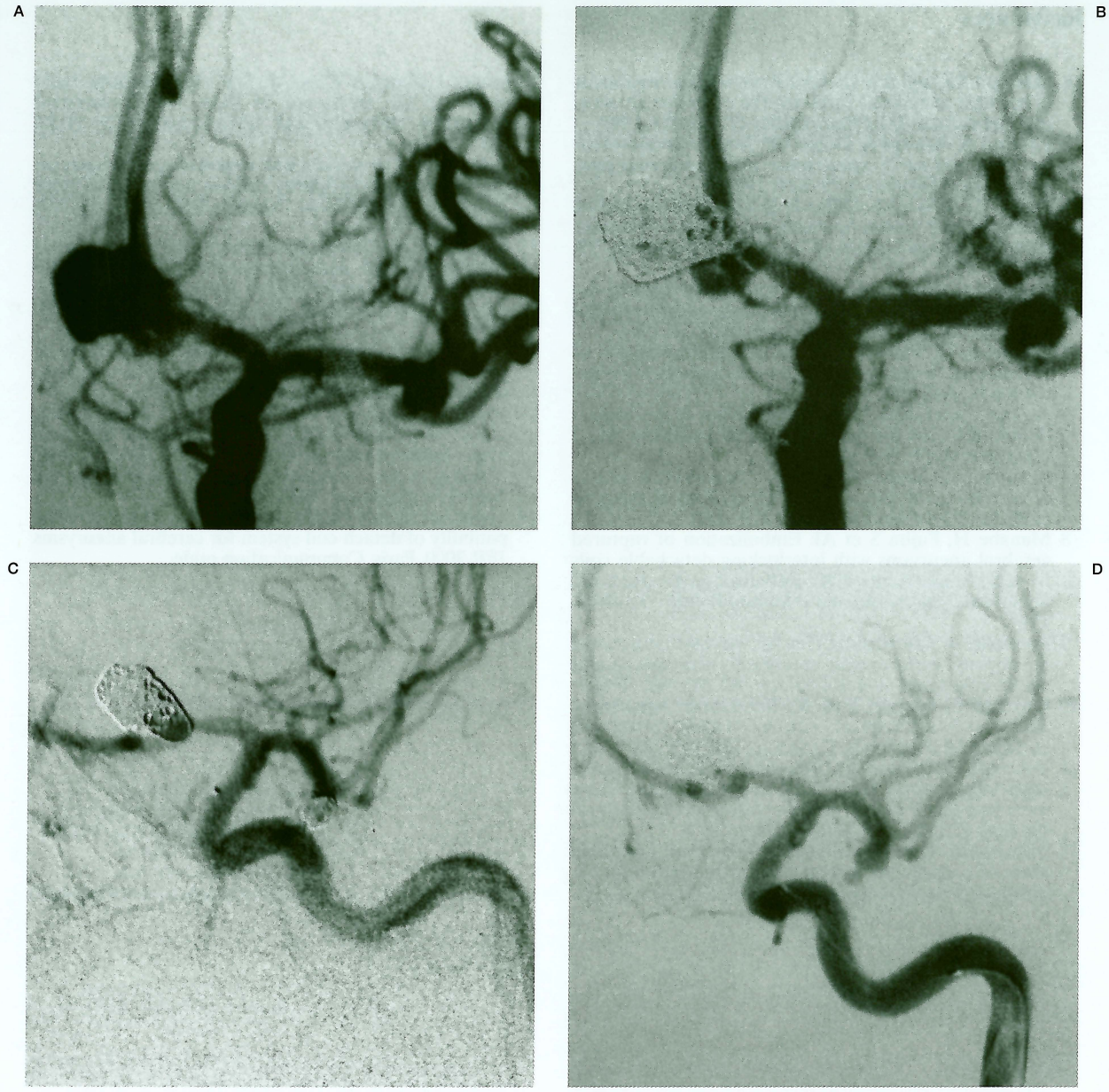


Figure 5 Embolization of multiple aneurysms: one aneurysm on the A1 segment and the second at the origin of the sylvian artery: in the same time embolization of both. Anterior cerebral aneurysm: in 45 minutes. 6 spiral coils, 3 J DCS 11, 3 S DCS 11. Sylvian aneurysm: in 40 minutes. 7 spiral coils, 1 DCS 11 J - 6 DCS 11 S.

chanical device in the endovascular treatment of intracranial aneurysms.

From 1993 in our institution, more then 250 aneurysms have been embolized by different systems including mechanical (MDS) and electrical (GDC) and our team is well trained in both techniques, considering that mechanical devices require a specific training as expert devices.

In conclusion, this new mechanical device (Detach Coil System) appears to be a safe, rapid, precise and reliable tool for the endovascular treatment of intra-cranial aneurysms.

From an economic point of view, the cost / efficiency ratio seems very interesting for an institution where endovascular treatment is increasing considerably.

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